

Evaluation of Humpback Chub Translocations in Shinumo Creek with Insights from Food Web Dynamics in Bright Angel Creek

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Grand Canyon NP



Questions

- How are the translocated HBC doing in Shinumo?
 - Are they staying in the system and why?
 - What is their growth, survival, and condition?
 - Is there resource overlap with native/non native fishes
- What resources is the fish community in Bright Angel using?
 - Is there diet overlap?
 - Do trout consume fish, and if so, how much?



Translocated HBC

902 total

2009: 302

2010: 300

2011: 300

Detection Efficiency

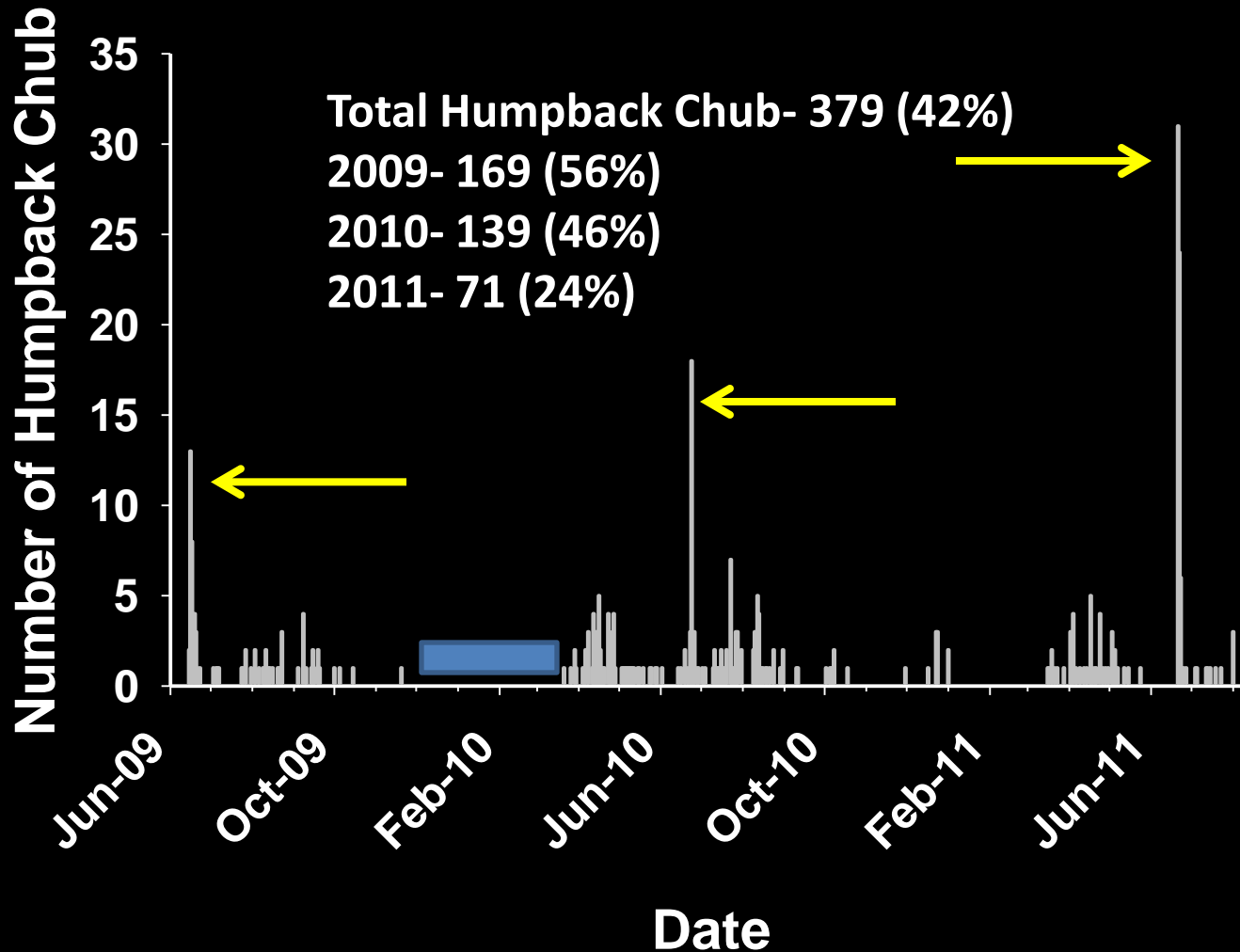
97 – 100 % individual detection (experiment)

51-87% detection (field; Lots of uncertainty)

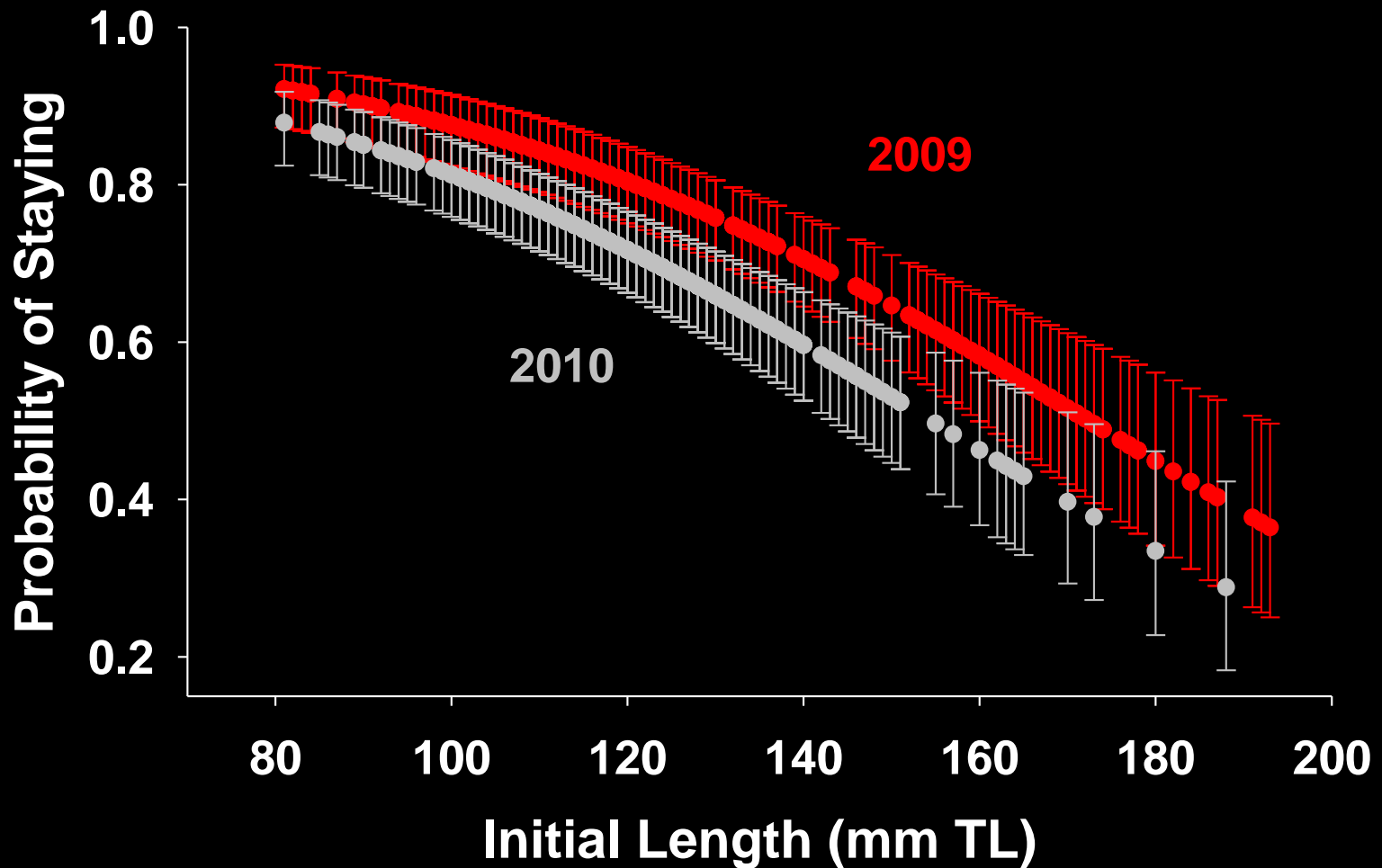


Emigration Results

through Aug 1, 2011



Initial Length



Emigration Summary

- **Dispersal from Shinumo Creek is high**
 - ✓ 42% of translocated HBC from 2009-2011 left Shinumo
 - ✓ 33% leave within the first nine days
- **Larger Individuals may be more likely to leave Shinumo Creek within the first growing season**
- **Hydrology may have an effect (more fish leave during higher flows/monsoons season)**

What About Growth and Condition?

Time period	Location	Mm/day	Source
Jun-Sep (2009, 2010)	Shinumo	0.28-0.31	This study
Jun-Sep 2010	LCR	0.24	C. Finch, U FL
First 90 days (2003-2005)	Chute Falls	0.26-0.55	FWS

No evidence of slower growth than other populations

Condition (relative weight)

Cohort	Mean Wr
2009	92-97
2010	81-96
2011	96

No evidence of low condition (93 is average for entire species)

Survival

Cormack Jolly Seber estimates

Multiple mark recapture in Shinumo

Cohort	<u>Apparent</u> annual survival	Annual emigration	Annual fidelity	Annual survival**
2009	0.22	0.48	0.52	0.41
2010	0.19	0.45	0.55	0.34

****strongly linked to emigration/detection**

2009 Translocation: 302 fish

Annual apparent survival (22%): 66 fish left

June 2010 population estimate (for 2009 fish only): 33 (10-106)

What about Species Interactions?

Does competition for food exist between natives and non-natives?

What is the consumption of invertebrates and fish by trout?
Shinumo and Bright Angel Creeks

Stable Isotopes

- Less invasive

What do they tell us?

- Food Source ($\delta^{13}\text{C}$)
- Trophic Position ($\delta^{15}\text{N}$)
- Long term diet habits

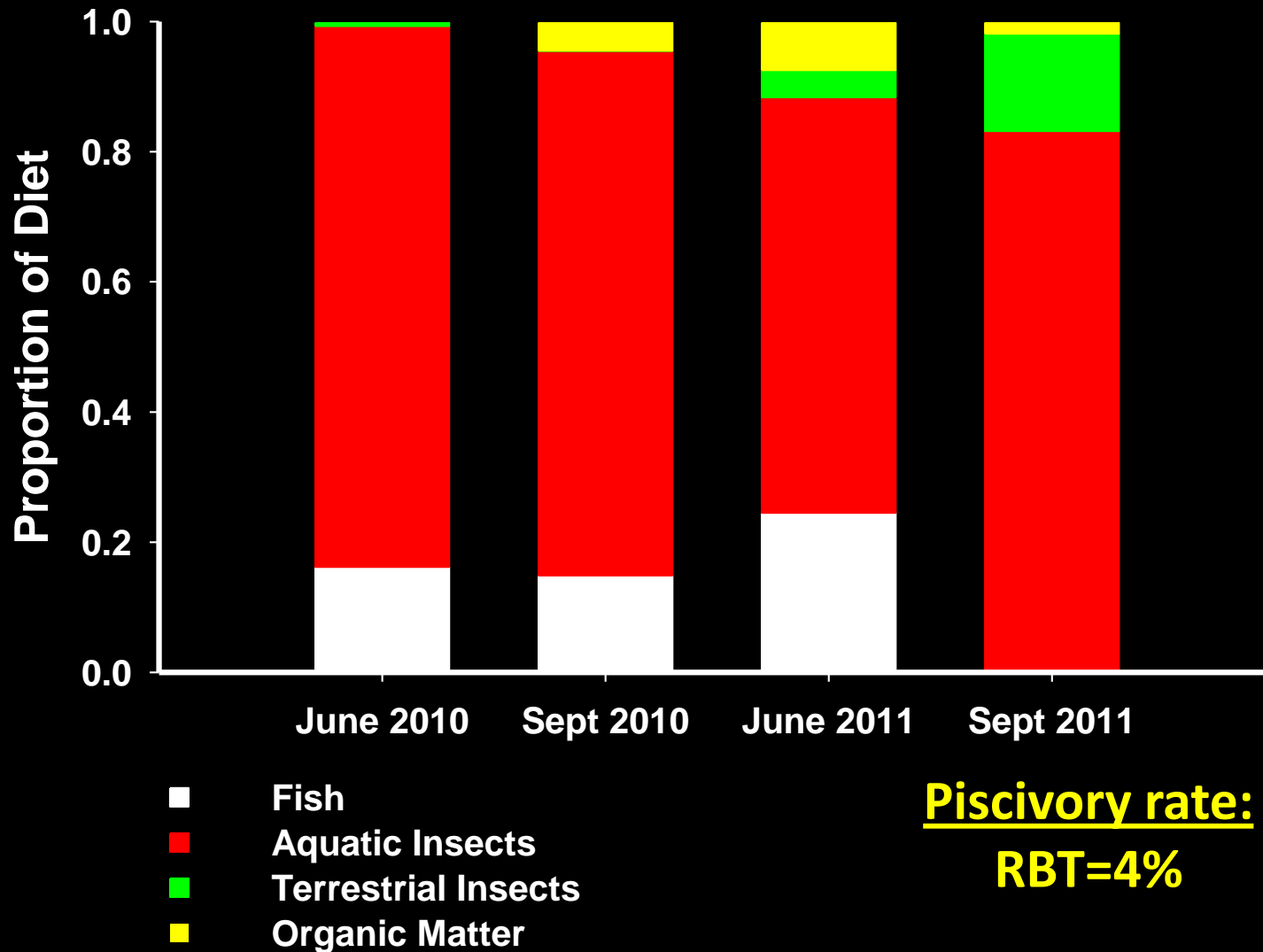
Stomach Content Analysis

- more invasive

What can they tell us?

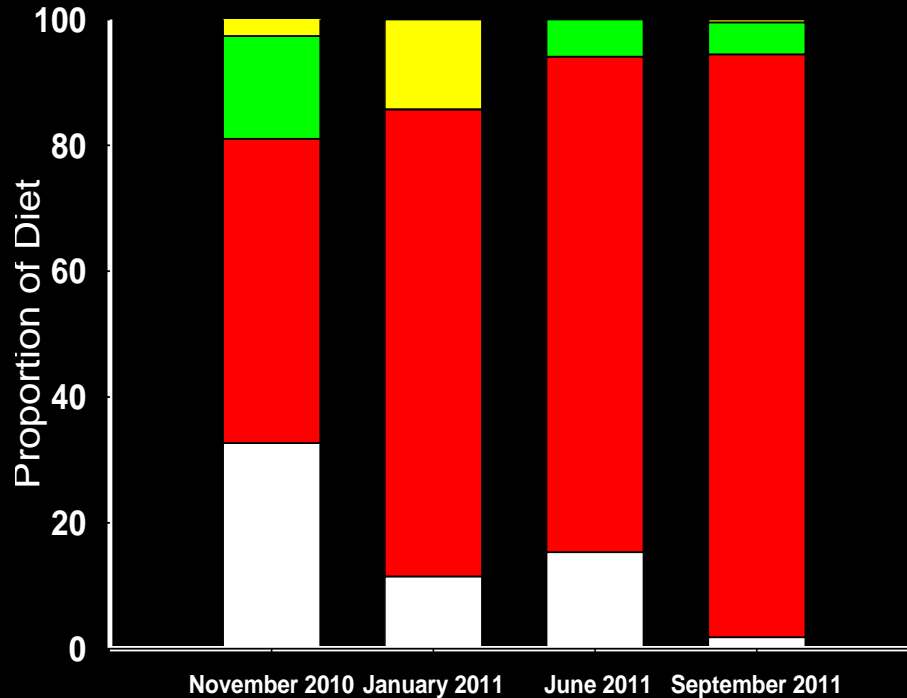
- Short term trends in diet
- Piscivory rates
- Identify actual diet items

Shinumo Creek Rainbow Trout Diets

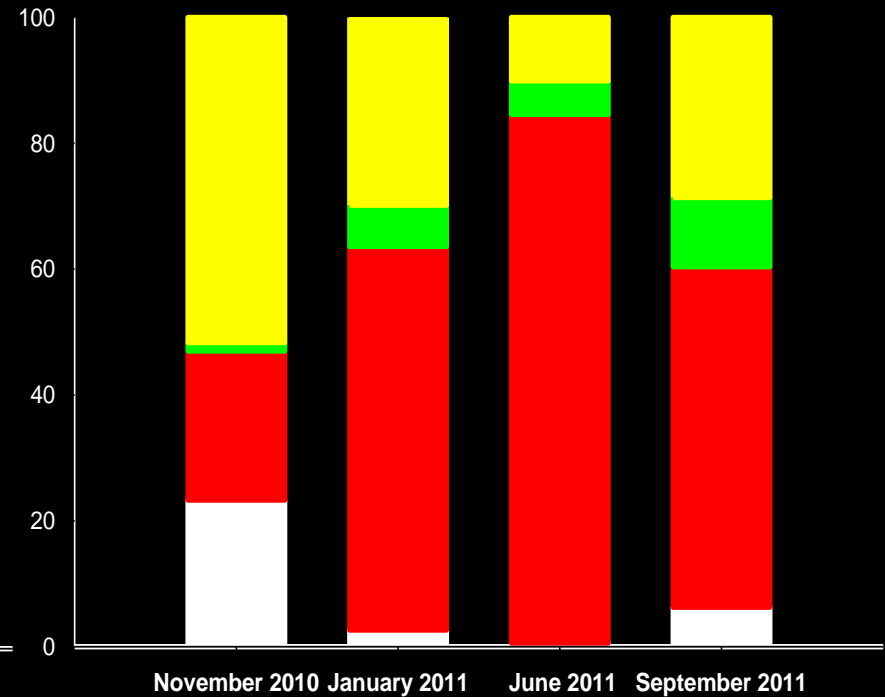


Bright Angel Creek Trout Diets

Brown Trout

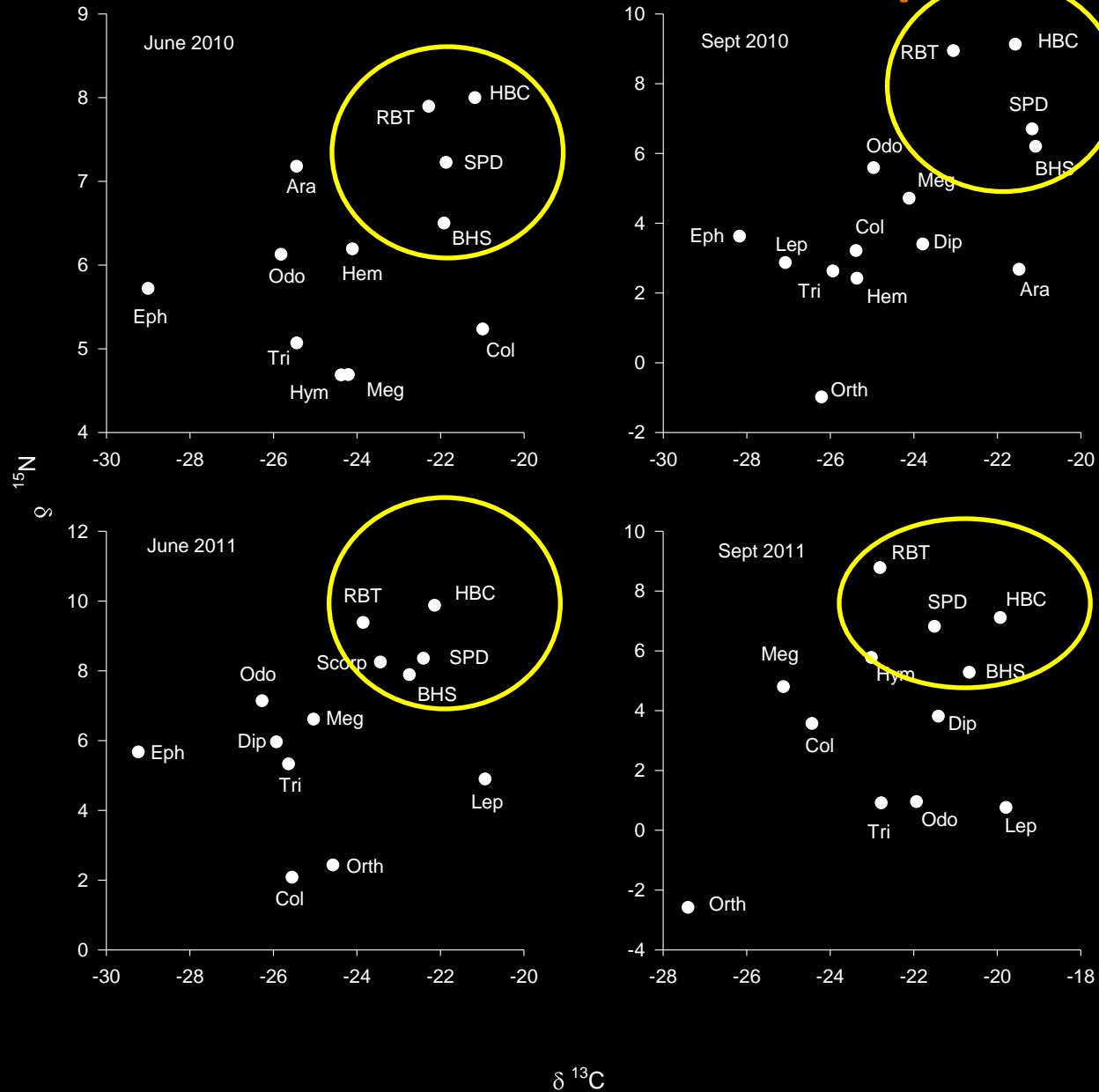


Rainbow Trout

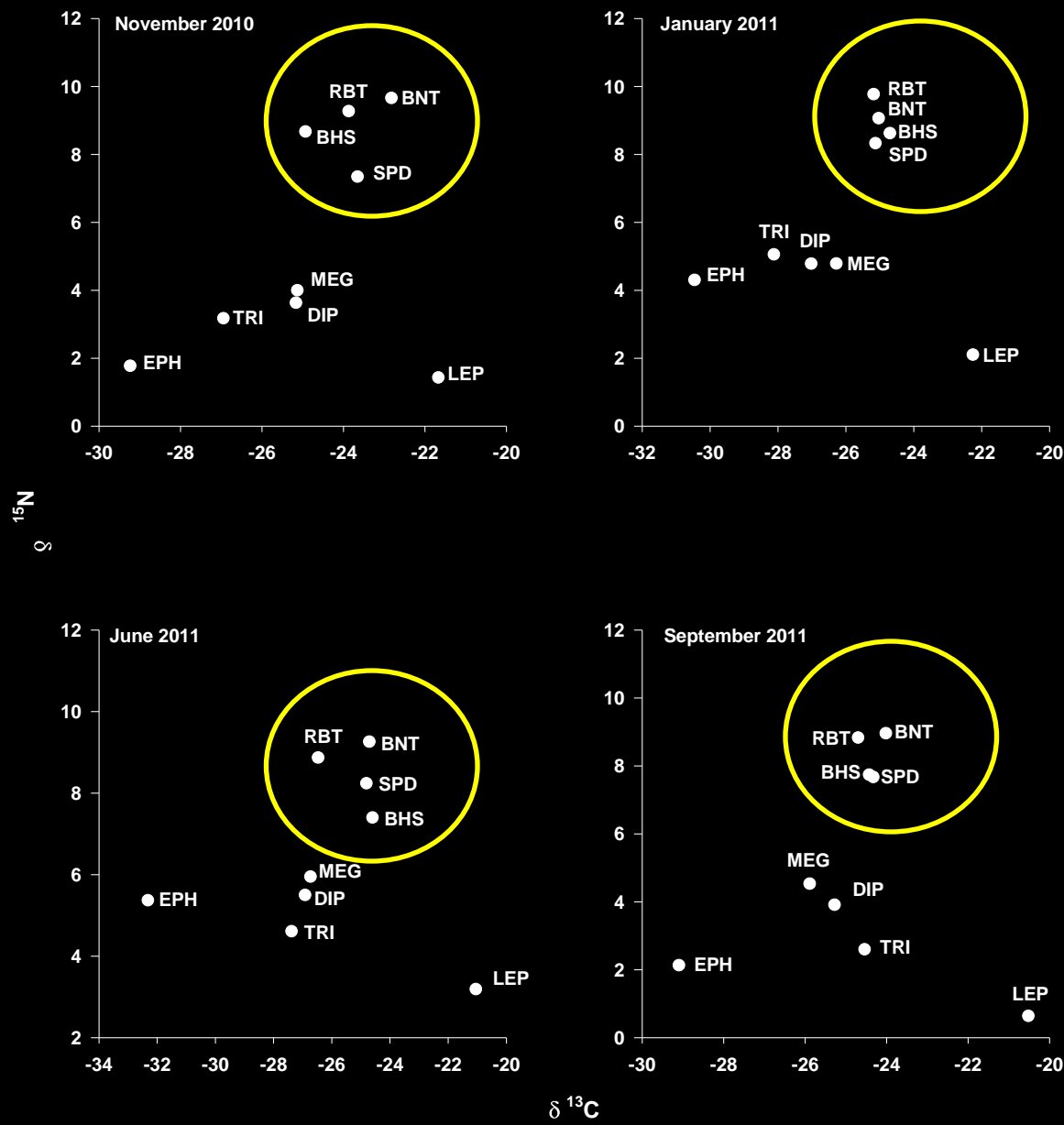


Piscivory rate:
BNT=18% RBT=5%

Shinumo Creek Isotopes



Bright Angel Creek Isotopes



Preliminary Food Web Conclusions

RBT in Shinumo Cr:

- ✓ occupied the highest trophic positions (with HBC)
- ✓ Consumed invertebrates and native fishes

RBT and BNT in BAC:

- ✓ occupied the highest trophic positions
- ✓ Consumed invertebrates and native fishes
- ✓ Had somewhat similar diets to native fishes

But what is the impact?

Bioenergetics Model

Physiological Parameters

Stomach contents

Water temperatures

Modeled for 1 year



Results: Bioenergetics

assumes no growth-minimum consumption estimates!

Food Type	BAC		Shinumo
	RBT	BNT	RBT
Fish	47 g	163 g	152 g
Aquatic Insects	625 g	833 g	640 g
Terrestrial Insects	58 g	59 g	41 g
Detritus	226 g	44 6	48 g
Total Consumption	956 g	1099 g	881 g

*Individual based model

*Consumption estimates are represented in grams

Results: Bioenergetics

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Aquatic Insects	625 g	833 g	640 g
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Detritus	226 g	44 g	48 g
Total Consumption	956 g	1099 g	881 g
# Fish Removed	419	539	970
Potential Fish	19,693 g	87,857 g	147,440 g
Removing trout 'saved': 107 kg of fish			147 kg of fish

Shinumo and Bright Angel Creeks

What We Know

Translocations

- About 42% of HBC emigrate (Large fish more likely)
- Most on the first 9 days
- Growth appears sufficient

Biotic Interactions

- Trout compete with and predate on natives
- Piscivory higher for BNT, but RBT and BNT consume fish
- Trout populations are consuming lots of native fish (and inverts)

Shinumo and Bright Angel Creeks

What We Don't Know

- How much food is available for natives and non natives?
- Cascading effects of non native removal (or native translocations)?
- Do HBC spawn/recruit in these tribs?
- What is the contribution of tributaries to the mainstem?
 - Nursery/grow-out location of mainstem fishes?
 - How do tributaries contribute to mainstem food resources?
 - Does removing trout free up substantial resources for tributaries and mainstem native fishes?

Acknowledgements

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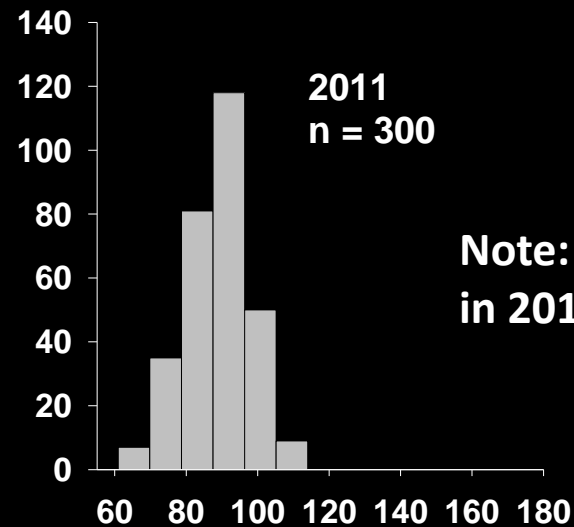
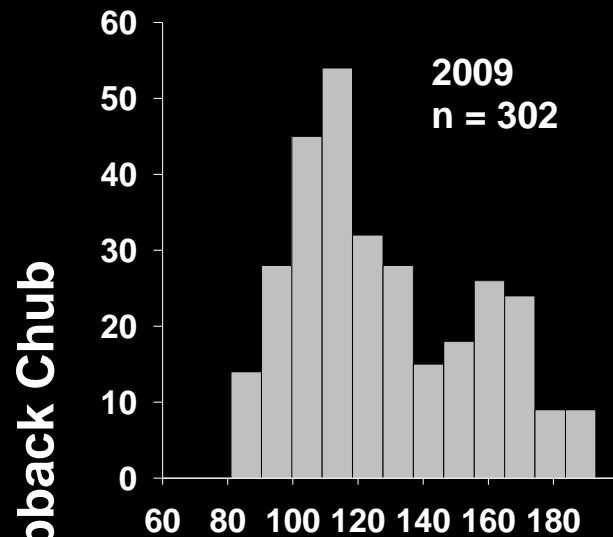
Grand Canyon Trust-Volunteers



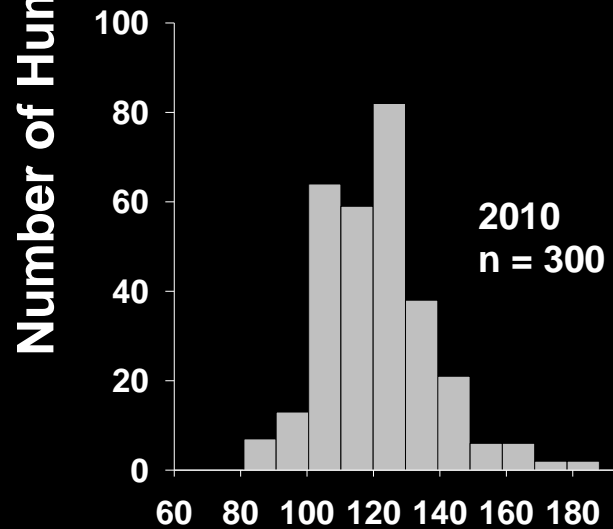


Questions?

Number and Size Structure of Translocated HBC



Note: few fish >100 mm in 2011



Initial Lengths (mm)

Emigration and Detection Efficiency

Emigration Assumptions:

Antenna 1 + Antenna 2 = Out of system

Antenna 1 only = Remain in system

Antenna 2 only = Out of system

Antenna 1 + Antenna 2 + Antenna 1 = Remain in system

Detection Efficiency

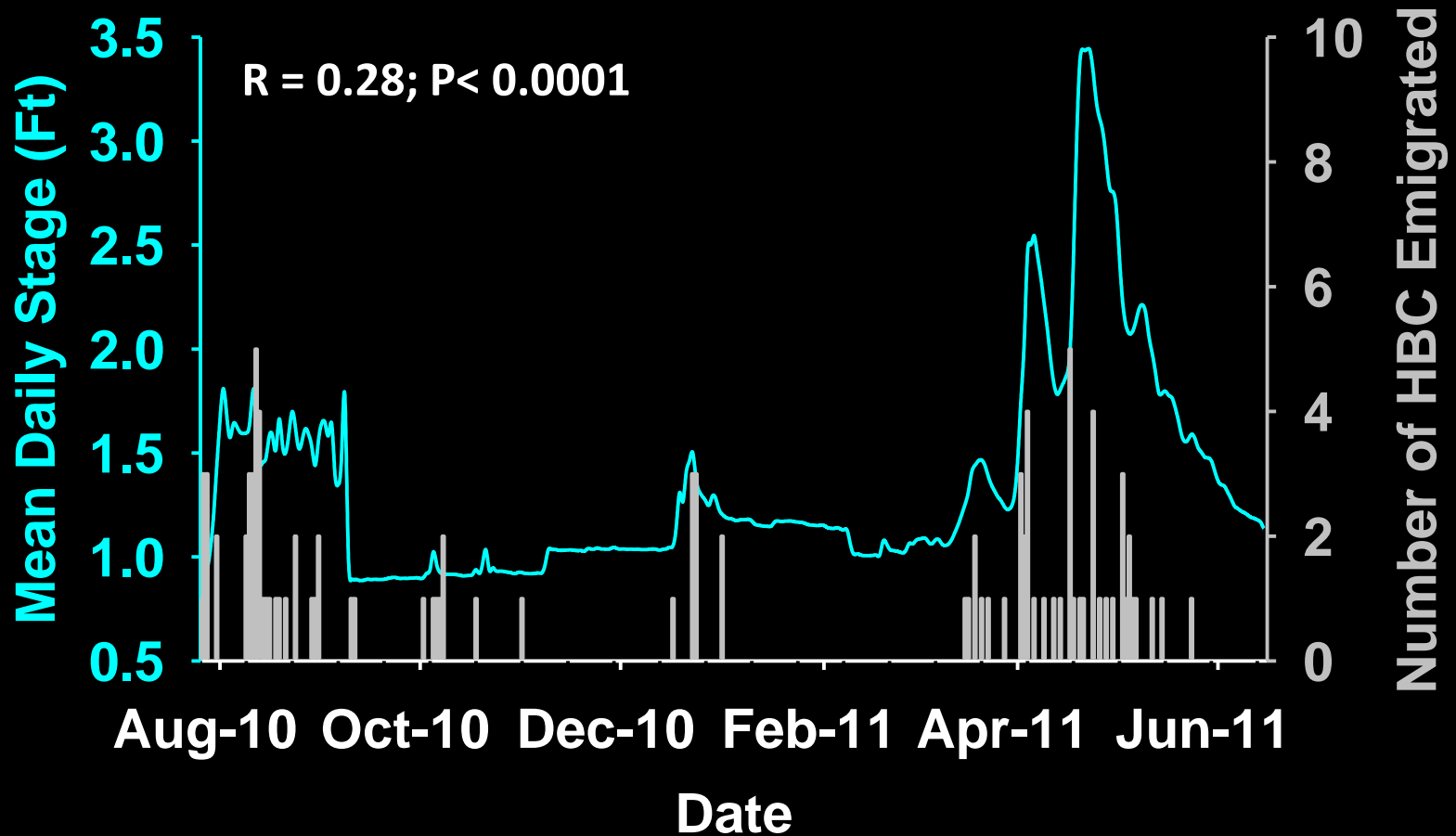
Individual Efficiency: 97 – 100 % detection

Group efficiency??

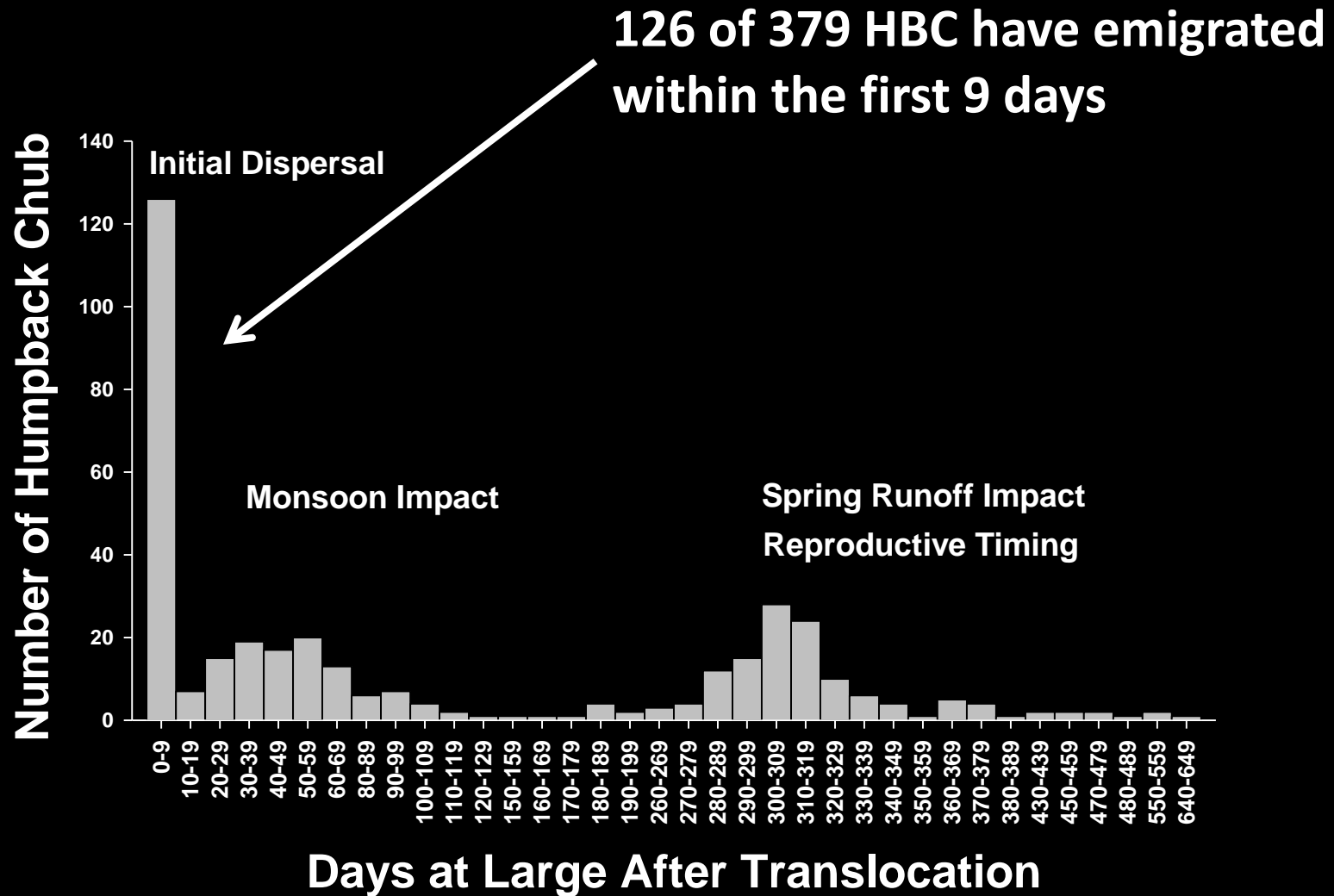
51-87% detection (Lots of uncertainty)



Hydrology



Potential Causes of Emigration



Piscivory

	Piscivory Rate (%)	# of Stomachs	Fish Length (mm)
Shinumo (RBT)	4	155	75 – 350
BAC (RBT)	5	135	68 - 490
BAC (BNT)	18	103	79 - 375

Very Preliminary Invertebrate Drift

Bright Angel Creek

	November	January	June	September
% Aquatic	87	97	88	76
% Terrestrial	13	3	12	24
Drift Density (mg/m ³)	1.3	1.8	0.7	0.9
Drift Rate (g day ⁻¹)	110.6	169.5	96.4	95.3

How does this (and other tribes) contribute to the mainstem food resources?

Does removing trout free up substantial resources for trib and mainstem native fishes?